

THE DINA GROUP OF THE GENUS EUREMA IN THE WEST INDIES (LEPIDOPTERA, PIERIDÆ)

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The group of species allied to *Eurema dina* Poey has long been a source of trouble to students of the West Indian fauna. The authors of both the modern revisions of the American sections of the genus (Klots, 1929; d'Almeida, 1936) were handicapped by lack of adequate West Indian material, and their treatment of the Antillean forms was consequently somewhat cursory. Bates (1934, et seq.), with more extensive material at hand, was able to make substantial progress; his results, however, appeared in a series of scattered papers, and were never collated in such a way as to make ready identification of the various forms possible. Some novelties have been described since the completion of Bates' work, and additional information makes it seem probable that some of his views were erroneous. A reasonably clear understanding of all the known West Indian forms can, in fact, now be obtained, and the time therefore seems ripe for the present brief revisional paper. The exploratory work of d'Almeida suggests that much more complex problems will be encountered in the mainland fauna, for the resolution of which a vast accumulation of specimens, and perhaps of biological data, will be required. In the present paper, therefore, no attempt will be made to discuss continental populations, except as they directly affect the West Indian situation.

Eight valid species of the *dina* group may now be distinguished in the West Indies. Although this is three more than were even tentatively recognized by Klots, subsequent modifications in the classification have not shaken, but rather have somewhat strengthened, the phylogenetic views which he expressed in 1928. The distal armature of the valve is broadest and most complex, and consequently in Klots' scheme the most advanced, in *dina* itself. In the geographically complementary and structurally extremely similar *leuce*, the armature is only slightly less specialized, but in the broadly overlapping *nise*, and still more in *neda* and the structurally similar *chamberlaini*, it is noticeably narrower and

simpler. In *lisa* the condition is still simpler, and is reminiscent of that which is found in the presumably ancestral *messalina* group. In the relict species *laræ* and *euterpiformis* the distal armature is very narrow, while the latter species is annectant in wing pattern as well as in genitalic structure to *messalina* and its allies. I hope to discuss the zoogeographic significance of these relationships in a later and more general paper; meanwhile it will suffice to point out the apparent existence of a fairly definite phylogenetic series within the group.

Although there has been much confusion in the classification of the West Indian forms, this has arisen mainly from difficulty in grouping the various populations to form species, rather than from difficulty in recognizing the populations themselves. Identification of subspecies is, in fact, quite easy, and now that an apparently satisfactory species grouping is available, the species may be identified with equal ease. Only in the *dina-leuce* complex will external characters lead primarily to subspecies rather than to species recognition, and there the affinities of all known populations have been determined on genitalic grounds or, in one case, on conclusive distributional evidence. The following key, therefore, should permit the identification to species of all known West Indian forms.

KEY TO THE WEST INDIAN SPECIES OF THE *Eurema dina* GROUP

1. Dark marginal band of fore wings evenly curved from just behind costa to near tornus, often very broad; apex of fore wing broadly rounded* 2.
 Dark marginal band of fore wings with its inner edge distinctly less curved opposite outer margin than opposite apex, or restricted to a small apical patch, or wanting; apex of fore wing often subacute 4.
2. Fore wing above with a small but definite dark discal bar *lisa*
 Fore wing above with no trace of a dark discal bar 3
3. Male with fuscous border of fore wing above as wide at tornus as at vein M_3 . Female unknown. Hispaniola *euterpiformis*
 Male with fuscous border of fore wing above much narrower at tornus than at vein M_3 . Cuba and mainland *neda*
4. Hind wings white or yellowish white above, paler, often contrastingly so, than the pale to bright yellow fore wings *nise*
 Ground color uniformly yellow, or with orange tints 5.
5. Delicate species, wings above with uniformly pale greenish yellow ground and narrow fuscous borders; rare and local in Cuba *laræ*

- If ground color uniformly yellow, the hue is brilliant, and the greenish tint scarcely perceptible; the only Cuban form has parts of the wing suffused with orange 6.
6. Length of fore wing not over 15 mm.; male with a narrow, but not linear, fuscous fore wing border; within this a narrow zone differing in texture and sometimes in color from the rest of the wing. Bahamas. *chamberlaini*
- Length of fore wing at least 18 mm.; male of Bahaman form with fuscous border of fore wings linear or obsolescent; no definite pale zone within the fuscous border 7.
7. Male genitalia with dorsal margin of valve forming an angle of nearly 90° with base** *dina*
- Male genitalia with dorsal margin of valve forming an angle of about 70° with base *leuce*

Remarks: (*) Trinidad specimens of *leuce* and *nise* often have the marginal band more regularly curved than is the case in material from the Antilles proper, and some individuals might consequently key to couplet 2. None of the species of couplet 2 ranges south of Antigua (or doubtfully Dominica) in the Antilles.

(**) Both *dina* and *leuce* are subject to such wide geographic variation that no simple combination of external characters will separate them along species lines. In the West Indies the two species overlap only in Hispaniola, where the *dina* form is bright orange, while the *leuce* form is yellow with local orange suffusion. To the east only *leuce*, and to the west only *dina*, occurs.

NOTES ON THE SPECIES

1. *Eurema euterpiformis* Munroe

Terias euterpe: Hall, 1925: 163. *Err. det.*

Eurema euterpiformis Munroe, 1947: 3.

Hall's description indicates clearly that he recognized this species; unfortunately he misidentified it as *euterpe*, which Ménétriés' illustration shows plainly to be a dark form of *lisa*. The material examined by the writer was confused in one collection with *lisa* and in another with *neda*. There is a certain amount of resemblance to both these species, but *euterpiformis* may, as pointed out in the key, immediately be distinguished by the form of the dark border, which is reminiscent of the *messalina* group. From the members of that group, *euterpiformis* differs in lacking the characteristic black dots on the under side of the hind wing. The ground color of the wings is of a purer yellow than in any other New World *Eurema* known to the writer;

all the other yellow species appear faintly greenish in comparison. No doubt there is some chemical peculiarity in the yellow pigment of *euterpiiformis*. The male genitalia show a considerable resemblance to those of *laræ*; this probably indicates no more than that neither species is far from the common ancestor of the *dina* group. There are significant differences in detail, while the two species differ radically in external appearance. Attention should be called to an error in the original description: reference is twice made on page 4 to the "anterior" process of the saccus; this is a careless mistake, the process actually being posterior, extending under the base of the valves.

The female and early stages are unknown.

The species is known only from Hispaniola, where it appears to be restricted to the higher altitudes, occurring, however, in both the southern and central cordilleras. Hall notes that he took it in a pine forest at La Vega. The holotype, a winter specimen from Kenscoff, has the marginal band of the wings much narrower than the two paratypes, which are late summer specimens from the central cordillera. It is not known whether this difference represents individual, seasonal, or local variation; it may be noted, however, that the direction of the variation is that which would be expected in seasonal forms.

2. *Eurema laræ* (Herrich-Schäffer)

Terias laræ Herrich-Schäffer, 1862: 120.

For many years this name stood in the synonymy of *dina*. The recapture of a delicately built, pale greenish-yellow form by Ramsden showed, however, that an entirely distinct form was concerned. Bates had already seen an old specimen, and published two notes on the species (1936; 1939); he was not able to examine the genitalia. These prove to be abundantly distinct from those of *dina*, and resemble those of *euterpiiformis* in general proportions; the principal differences from *euterpiiformis* lie in the uncus, which has a normal Y-shape instead of a V-shape, in the saccus, which is shorter and stouter, and in the dorsal ligament of the valve, which is shorter and broader.

The species is endemic in Cuba, where it is of very local occurrence. Gundlach records it from Loma Vigia in the Trinidad Range, and from Bayamo, near Holguin; Ramsden's specimens

came from Jiguani, near Guantanamo. The species has been captured in both summer and winter.

The life history is unknown, but Gundlach (1881a) noted that he always found the species in groves of *Tecoma stans* (Bignoniaceæ), which he accordingly thought might be the food plant. However, a non-leguminous food plant would be most unusual for a species of this genus, so that it is possible that some associated legume, rather than *Tecoma* itself, will eventually prove to be the host.

Material examined: about a dozen specimens in the American Museum of Natural History.

3. *Eurema lisa* (Boisduval and Leconte)

Xanthidia lisa Boisduval and Leconte, 1830: 53.

Comstock (1944) has pointed out that on the average West Indian specimens are smaller in size and have narrower dark wing borders than those from North America. On this basis he recognizes the West Indian population as a distinct subspecies. The differences are rather nebulous, and individual specimens are not identifiable with any great accuracy; however, as the distinction may have some zoogeographic value, it is retained here.

a. *Eurema lisa euterpe* (Ménétriés)

Colias euterpe Ménétriés, 1832: 299.

Terias sulphurina Poey, 1851: 248.

Eurema lisa euterpe: Klots, 1929: 138.

As Comstock noted, the Puerto Rican and Lesser Antillean populations are most strongly differentiated from the North American form, those from Hispaniola and Cuba approaching it more closely in proportion of phenotypes. Conversely, there would appear to be some West Indian influence in the population of Southern Florida.

The species is abundant in open country throughout the Greater and the northern Lesser Antilles, at altitudes up to about 5000 feet. The West Indian distribution is almost exactly complementary to that of the equally common *Eurema nise*, which occupies similar habitats in the southern Lesser Antilles, and it is possible that competition prevents the co-existence of the two species.

The life history has been described in detail by Dethier (1940), on the basis of Cuban material. The food plant in the West Indies is *Cassia*, but other leguminous hosts have been recorded in North America.

Material examined: 891 specimens in the American Museum, the Carnegie Museum, the Museum of Comparative Zoology, Cornell University, and the Lyman Collection, from New Providence, Cuba, I. of Pines, Jamaica, Hispaniola, Puerto Rico, St. Thomas, St. Croix, St. Eustatius, St. Kitts, Antigua, and Dominica. The Dominica specimen is perhaps mislabeled, as the species is at least extremely rare south of Antigua. Carpenter and Lewis (1943) have recorded the species from Grand Cayman.

4. *Eurema neda* (Latreille)

Pieris neda Latreille, 1819: 135.

Terias stygmula Boisduval, 1836: 661.

Terias venusta: Lucas, 1857: 505.

Terias nelphe Felder, 1869: 446.

Eurema nise perimede: Klots, 1929: 105.

Terias neda: d'Almeida, 1936: 239.

This species and its close allies are widespread on the mainland, but the occurrence in the West Indies is very restricted, only one definite locality in Cuba being known. There is also a colony in southern Florida. More adequate material will be necessary before the subspecific status of these populations can be definitely determined, but they certainly resemble the typical Central American form quite closely. D'Almeida has figured the male genitalia (1936, pl. 4); the valves of Florida specimens examined by the writer had two or three additional distal teeth, but this character is not necessarily very significant.

The life history appears to be unknown, but the closely allied Brazilian species *tenella* feeds on *Mimosa pudica*; its life history has been described by d'Almeida.

Material examined: 5 males, 2 females in the Museum of Comparative Zoology from Soledad, Sta. Clara, Cuba; 1 male in the American Museum of Natural History labelled "Cuba", from the collection of Jacob Doll; also a series in the American Museum of Natural History from Royal Palm State Park, Florida. Bates states that the species was common during his stay at

Soledad; it is remarkable that it has not turned up elsewhere in Cuba.

5. *Eurema chamberlaini* (Butler)

Terias chamberlaini Butler, 1897: 295.

This little-known species is alike remarkable in being one of the few endemic butterflies of the Bahamas and in being one of the few to show conspicuous subspeciation within the Bahamas. The male genitalia are closely similar to those of *neda*, and the two species also agree, and differ from *dina*, in having an area of pearly white scales in the region anterior to subcosta of the hind wing. *E. chamberlaini* differs strikingly from *neda* in external appearance, however, and I consider the acute apex of the fore wings, the narrow and straight-bordered marginal band, and particularly the submarginal zone of modified scaling, as constituting characters of specific value.

a. *Eurema chamberlaini chamberlaini* (Butler)

Terias chamberlaini Butler, 1897: 295.

Eurema chamberlaini banksi Clench, 1942: 1. New synonymy.

This species was described on the basis of a single male collected in the Bahamas by Mr. (later the Rt. Hon.) Neville Chamberlain. Butler calls the ground color of the type "gamboge yellow", i.e., clear, brilliant yellow. The island on which the type was collected was not specified, but Petrie's (1938) biography of Chamberlain yields the information that, while he made a general tour of the outer islands in about the year 1890, he spent a period of at least five years at a sisal plantation on Andros. There is thus a very strong probability that the type of *chamberlaini* came from Andros, and, until definite evidence to the contrary appears, this view may be accepted.

Material from Andros has not been available for examination, but three summer males, two in the American Museum of Natural History and one in the Carnegie Museum, from New Providence, agree reasonably well with the original description, although the ground color is sulphur, rather than gamboge yellow. Accordingly, the New Providence population may provisionally be considered to be equivalent to that of the neighboring island of Andros; that is, it may be referred to the typical subspecies.

These three examples have a fore wing length of about 15 mm. Another male in the American Museum of Natural History, also from New Providence, but collected in February, is somewhat smaller, and differs strikingly in having the wings irregularly flushed with orange, leaving, however, on the fore wings a definite narrow submarginal band of pale yellow. The writer regards this difference as representing a seasonal dimorphism. This winter specimen does not differ significantly from the holotype of *E. chamberlaini banksi* Clench, a male from Cat Island, also taken in February; without further material, therefore, there would appear to be no basis for the retention of Clench's name. The only female known of *chamberlaini chamberlaini* is the allotype of *banksi*, which has been fully described by Clench.

Two males from Watling Island and one male from Crooked Island differ in certain respects from typical *chamberlaini*. The writer agrees with Clench that in the absence of further material the importance of these differences cannot be assessed.

Material examined: 5 males, 1 female, as detailed above.

It should be noted that d'Almeida (1936: 258) has inadvertently substituted the original description of *Eurema dina helios* Bates for that of *chamberlaini* in his account of this subspecies.

b. *Eurema chamberlaini inaguae* new subspecies

Eurema chamberlaini chamberlaini: Bates, 1934: 134.

Err. det.

The type material of this subspecies has already been carefully described by Bates, who considered it to be equivalent to Butler's *chamberlaini*. The Inagua material, however, clearly disagrees with the original description of *chamberlaini* in having the ground color brilliant orange, and not "gamboge yellow". For this reason, and in view of the evidence adduced above as to the type locality of *chamberlaini*, Bates' identification cannot be sustained. The Inagua population is thus left without a name, and the name *inaguae* is accordingly proposed, to parallel Bates' designation of the following subspecies.

Holotype male, allotype female, and four male paratypes in the Museum of Comparative Zoology, Cambridge, Mass., all taken on Great Inagua in February. Two specimens in the Carnegie Museum, Pittsburgh, taken at Matthew's Town, Great Inagua, in March, are similar, but as the writer has not compared these

directly with the M.C.Z. series he refrains from including them in the type material.

c. *Eurema chamberlaini mariguanae* Bates

Eurema chamberlaini mariguanae Bates, 1934: 135.

Although known only from three specimens, this subspecies clearly represents a population distinct from the ones discussed above. The most characteristic feature is the presence of a definite dark discocellular dot on the upper side of the male fore wing. The female is orange shaded with yellow above, and uniformly yellow beneath. The subspecies is known only from Mariguana Island. The type series was collected in February.

Material examined: 2 males, 1 female (type series), in the Museum of Comparative Zoology.

6. *Eurema nise* (Cramer)

Papilio nise Cramer, 1775, 1: 31, pl. 20.

Opinions have differed as to the correct application of this name. It is here used in the traditional sense for the species with bright yellow fore wings which normally contrast with the pale yellow or white hind wings. Cramer's figure, however, shows a female with a uniformly pale yellow ground color. On this account, Klots (1929) felt obliged to abandon the previously accepted usage and to apply the name *nise* to the Central American species here called *neda*, together with its South American representatives, leaving *venusta* Boisduval as the oldest name for the present species.

On the other hand, d'Almeida (1936: 245) states that he has seen Venezuelan females which are identical with Cramer's figure, whereas if it is to be identified with *neda* certain inaccuracies in the figure must be assumed. The writer was able to find similar specimens from the Guianas in the collection at Cornell University, and, in fact, it is not uncommon for somewhat worn females to have the ground color of the fore wing as pale as that of the hind wing, especially in the mainland populations. D'Almeida's return to the traditional concept of *nise* is therefore plausible.

An important supporting consideration not mentioned by d'Almeida is that of locality. Cramer gave the locality of his

material as Jamaica. No similar form has appeared in modern collections from Jamaica, and it is reasonable to conclude that this locality was erroneous. Assuming this to be true, an examination of the sources of Cramer's Neotropical material shows that the most probable alternative locality is Surinam. Now, *neda* and its close relatives range from Central America to the São Paulo region of Brazil, but seem to avoid the northeastern coastal region of South America, apparently not being recorded from the Guianas or from Trinidad, although the present species is common in both those areas. The weight of probability would therefore appear to be in favor of d'Almeida's view, and it is accepted here.

The male genitalia, which have been illustrated by d'Almeida, are intermediate between those of *neda* on the one hand and *leuce* on the other, the broader and more complex distal armature of the latter already being presaged. The external appearance also shows an interesting ambivalence: the typical, continental populations, and to a lesser extent that of Trinidad, have broadly rounded fore wings and a broad, curved marginal band, essentially similar to that of *neda*. The populations of the Lesser Antilles proper, on the other hand, are characterized by fore wings with a narrow, wedge-shaped marginal band and in many individuals with a subacute apex, so that they bear a considerable resemblance to *dina* or *leuce*. This Antillean population has recently been named by Dillon.

a. *Eurema nise emanona* (Dillon) new combination

Terias deva: Godman and Salvin, 1884: 317.

Terias limbia: Godman and Salvin, 1896: 518.

Terias venusta: Slater, 1901: 223.

Terias nise: Röber, 1910: 83.

Terias deba: Dyar, 1914: 424.

Eurema venusta emanona Dillon, 1947: 100.

The Lesser Antillean populations of *nise* are uniformly characterized by the extremely narrow marginal band of the fore wings above. The apex of the fore wings is on the average more acute than in the continental forms, but this character is not sufficiently constant to be of diagnostic value. The ground color of the wings is normally at least faintly, and often conspicuously, deeper yellow than that of the hind wings, but occasional speci-

mens fail to show this contrast. Such individuals might be confused with *leuce antillarum*, and as the writer has seen only a single specimen of the latter form he is not in a position to give definite diagnostic characters. Any specimen, however, with uniformly lemon yellow fore and hind wings can safely be considered *leuce*; those with uniformly very pale yellow ground color should be treated with reserve. Trinidad specimens of *leuce* often have a conspicuous rusty orange patch at the apex of the hind wings beneath; no such patch is found in *nise emanona*.

This subspecies was described from Dominica, where it occurs in overwhelming numbers, particularly in the open, cultivated ground of the lowlands; it is, however, common throughout the main chain of the Lesser Antilles from Grenada north to Guadeloupe. The life history, in spite of the abundance of the species, appears to be unknown.

Material examined: 96 specimens, including much of what has subsequently become the type material of *emanona*, in the American Museum of Natural History, the Museum of Comparative Zoology, the Cornell University Collection, and the Lyman Collection, from the following localities: Grenada, St. Vincent, St. Lucia, Martinique, Dominica, and Guadeloupe. In addition, there are published records from Barbados (Godman and Salvin) and St. Thomas (Klots); the first of these requires confirmation and the second is almost certainly erroneous. Godman and Salvin give the upper altitude limit as 1000 feet on St. Vincent.

7. *Eurema leuce* (Boisduval)

Terias leuce Boisduval, 1836: 659.

The relationship between this and the following species, *dina*, is very close, and has given rise to considerable confusion. Typical *dina* and typical *leuce* differ considerably in superficial appearance, the former having an extensive orange suffusion which is lacking in the latter, and the two were of course described as distinct species. In the course of time an assemblage of Central American and Antillean forms became associated in the synonymy of *dina*, while a similar accumulation of names of South American application gathered about *leuce*. With the enormous clarification of the relationships of the New World *Euremas* which accompanied Klots' revision (1928, 1929), the

close affinity of the two assemblages became apparent, and Klots united all the *dina* and *leuce* forms in a single polytypic species.

D'Almeida in 1936, however, in a genitalic study of a considerable number of specimens, noted that the ædæagus of *leuce* tended to be longer and less sharply curved than that of the *dina* forms, and on this basis he separated the two species once more. On the other hand, Comstock (1944) was more impressed by the similarities in the genitalia and general appearance among the various forms than by the admittedly somewhat inconstant difference in the ædæagus, and rejected d'Almeida's separation. Meanwhile Bates (1939) had revealed a new element in the problem by his discovery that two quite distinct *dina*-like forms existed sympatrically in Hispaniola. One of these has a brilliant orange ground color and a linear marginal band, the other, *memulus* Butler, is closely similar in appearance to typical *dina*, having the ground color yellow washed with orange and the marginal band broad and curving along the costa. This superficial difference is not in itself astonishing, for equally large differences exist between apparently conspecific *dina*-like forms in Central America, but Bates was also able to demonstrate genitalic differences, relating chiefly to the proportional development of the valve armature, between the two forms. It was obvious that two species were involved, and Bates correctly associated the uniformly orange form, which he named *mayobanex*, with the Bahaman subspecies *helios*. The superficial similarity of *memulus* to typical *dina* misled him into considering them conspecific, and he was accordingly forced to consider the *helios-mayobanex* complex as a separate and self-contained species, with a decidedly anomalous distribution pattern.

If an attempt is made to extend the differences in proportional development of the armature which Bates observed between *memulus* and *mayobanex* to other populations in the *dina* complex, anomalous results are soon encountered. Thus, *dina dina* does indeed go with *memulus*, but the very similar Jamaican *parvumbra* must on this criterion be associated with *helios* and *mayobanex*. Another set of differences, however, distinguishes the genitalia of *memulus* from those of *mayobanex*; these are concerned with the overall proportions of different parts of the genitalia, notably of the valves, and are accordingly of the same

class as the differences which distinguish such obviously separate species as *neda* and *nise* from the *dina-leuce* complex. The extension of these differences to the remaining populations reveals at once a clear and distinct separation into two groups, each with negligible internal variation, even between widely separated populations. These two groups, moreover, have a regular and entirely normal pattern of geographic distribution, the *dina* group extending from Central America into the Greater Antilles as far as Hispaniola, and the *leuce* group penetrating from South America up the Lesser Antilles to Puerto Rico and again to Hispaniola. It is obvious that this arrangement is the natural one, that the two groups represent distinct and partly sympatric species, and that d'Almeida's separation of *dina* and *leuce* was essentially correct.

The following table will outline the principal differences in valve proportions between *dina* and *leuce*; the values given are means, but there is remarkably little difference, either individual or local, in these basic proportions within the species. The measurements were made from specimens preserved in fluid, and will not be applicable to specimens flattened on slides; it is almost impossible to control the degree of distortion in specimens so flattened, and they are valueless for purposes of comparative measurement. Thus d'Almeida's figures, obviously based on slide material, reveal qualitatively the differences in proportion between *dina* and *leuce*, but obscure the actual constancy of these differences in undistorted material. The same difficulty was encountered in the study of some of Klots' original slide material, which is preserved at Cornell University, although in this case it is known that a special effort was made to minimize and standardize distortion. In the writer's opinion the dangers attendant upon distortion are equally great in almost all groups of the genus, and genitalic material of *Eurema* should invariably be studied and *preserved* in fluid, e.g., glycerine-alcohol, if critical differences are to be resolved.

Some explanation of the following measurements is necessary: the line representing the base of the valve is taken as a line connecting the dorsal and ventral angles, neglecting the slender dorsal articular process; the remaining lines were obtained by

producing the longest approximately straight portion of the margin in question.

MEAN PROPORTIONS OF VALVE IN *Eurema dina* AND *leuce*

Measurement	<i>dina</i>	<i>leuce</i>
Angle between costa and base	84°	68°
Angle between distal margin and base	19°	27°
Angle between ventral margin and base	63°	70°
Ratio of distance between base of process "b" and base of process "d" to distance between base of process "d" and distal angle (terminology of Klots)	1.25	0.66

The ædæagus characters employed by d'Almeida segregate the populations along similar lines, as shown in the following table. The measurements again require explanation: the length of the ædæagus is taken in terms of the length of the valve considered as unity; the curvature was measured by drawing a chord connecting the basal and distal extremities of the ædæagus and dividing its length into the greatest perpendicular distance from the ædæagus to the chord. The populations are classified into species on the basis of the valve characters so that a ready comparison with the cleavage of the ædæagus characters can be made.

ÆDEAGUS MEASUREMENTS OF VARIOUS POPULATIONS OF THE *dina-leuce* COMPLEX

Population	length	curvature
<i>leuce pseudoleuce</i>	1.66	0.30
" <i>sanjuanensis</i>	1.68	0.28
" <i>memulus</i>	1.80	0.33
<i>dina mayobanex</i>	1.45	0.28
" <i>helios</i>	1.45	not measured
" <i>parvumbra</i>	1.45	0.28
" <i>dina</i>	1.47	not measured
" <i>westwoodii</i>	1.43	0.30

The difference in relative length of the ædæagus in the two species is very obvious; that in curvature is one of means rather than an absolute one, and may not really be significant.

As here understood, the species *leuce* is represented in the Antilles proper by three subspecies, the subspecies *pseudoleuce* d'Almeida, recognized as distinct by Comstock (1944), being

apparently confined to Trinidad and hence extralimital. These subspecies may be separated by the following key.

1. Ground color above yellow, locally flushed with orange; marginal band of moderate width. Hispaniola *memulus*
 Ground color above clear lemon yellow, without orange tints; marginal band extremely narrow 2
2. Maximum width of dark marginal band in male 1 to 1.5 mm. Lesser Antilles *antillarum*
 Maximum width of dark marginal band in male 0.5 mm. Puerto Rico *sanjuanensis*

The writer has seen no description of the life history.

a. *Eurema leuce antillarum* (Hall) new combination

Terias leuce antillarum Hall, 1936: 275.

Eurema dina antillarum: Comstock, 1944: 526.

In large part sympatric with *nise emanona*, but much scarcer. Differentiation between these two species is ordinarily possible by the uniform ground color in *leuce* as compared with the contrastingly pale hind wings in *nise*. Occasional specimens, particularly females, of *nise emanona* have a uniform ground color, and here trouble is likely to be encountered. In the Trinidad subspecies of *leuce* (*pseudoleuce* d'Almeida) there is usually a rusty patch at the apex of the hind wing beneath, which is never found in *nise emanona*. The only specimen of *leuce antillarum* examined by the writer, a female which he took in St. Kitts, now in the collection of Mr. René Lichy of Caracas, this patch was present; it is sometimes lacking in *leuce pseudoleuce*, however, and in the absence of further material it is impossible to give characters which will invariably separate the two species in the Lesser Antilles.

Material examined: 1 female, taken on Monkey Hill, St. Kitts, in June. Hall has also recorded the subspecies from Dominica and St. Lucia.

b. *Eurema leuce sanjuanensis* (Watson) new combination

Eurema sanjuanensis Watson, 1938: 1.

Eurema dina sanjuanensis: Comstock, 1944: 525.

The unique holotype of this species has been fully described and illustrated by Comstock (1944). His excellent figure of the genitalia (made from a specimen in fluid preservative) shows beyond question that it goes with *leuce* rather than with *dina*.

If the single specimen is representative of the population, *santjuanensis* is distinguishable from *antillarum* by its larger size and considerably narrower dark wing border.

Material examined: 1 specimen (holotype), San Juan, Puerto Rico, July.

c. *Eurema leuce memulus* (Butler) new combination

Terias memulus Butler, 1871: 251.

Terias citrina: Hall, 1925, 164.

Eurema dina memulus: Watson, 1938: 2.

The conspicuous orange flush and broad black borders of the wings of this subspecies give it a striking resemblance to *Eurema dina dina* from Cuba. On this account previous authors have associated it with that form, but the genitalia leave no doubt as to its real relationships. The subspecies has been taken at various altitudes and localities in Hispaniola, from 500 to 2500 feet above sea level. Like the other Antillean subspecies of *leuce*, it is rare.

Material examined: 3 males, 1 female, in the American Museum of Natural History and the Museum of Comparative Zoology.

8. *Eurema dina* (Poey)

Terias dina Poey, 1832, no. 11.

This species ranges through Central America and into the Greater Antillean area, with extensive color variation. Each of the Antillean populations is fairly uniform, although there is a little seasonal variation in the width of the dark border of the wings. The Central American population (*dina westwoodii* Boisduval) is, however, highly polymorphic, and individuals can be selected to match almost any of the West Indian subspecies. The relative uniformity of the West Indian populations may well be due to Wrightian scattering of variability; in the absence of more complete information as to the basis of the observed variability and the history and population numbers of the West Indian forms it is impossible to accept this conclusion with entire confidence, but the presence of a yellow form in the normally orange Bahaman population suggests that at least this color character may be determined by a single gene difference.

The life history of *dina* appears to be unknown.

The following key will separate the West Indian subspecies:

1. Dark border of fore wings linear or obsolete; ground color normally orange 2
- Dark border of fore wings at least 1 mm. wide at apex in male, represented at least by a definite apical patch in female; ground color normally yellow locally flushed with orange 3
2. Length of fore wing about 18 mm.; Bahamas *helios*
Length of fore wing about 20 mm.; Hispaniola *mayobanex*
3. Dark border of fore wings little more than 1 mm. wide at apex in male; in female represented by a triangular apical patch; Jamaica. *parvumbra*

Dark border of fore wings continuous in both sexes, broadly curved to form an apical patch 3 to 5 mm. in width; Cuba and I. of Pines *dina*

a. *Eurema dina dina* (Poey)

Terias dina Poey, 1832, no. 11.

Terias citrina Poey, 1852: 247.

Terias westwoodii: Lucas, 1857: 507.

Eurema dina: Gundlach, 1881: 112.

Eurema dina dina: Klots, 1929: 139.

Widely distributed in Cuba and the Isle of Pines up to an altitude of about 3000 ft. There is minor seasonal variation: winter specimens tend to have the marginal band somewhat narrower than those taken in the summer, and frequently lack its costal extension. Probably owing to local variations in the seasonal rainfall cycle, the correlation of variation with date of capture is not too precise. The name *citrina* applies to extreme specimens of the winter type. The species occurs in all parts of Cuba, but is apparently most common in Oriente.

Material examined: 118 specimens, in the American Museum of Natural History, the Carnegie Museum, the Museum of Comparative Zoology, and the Cornell University collection.

b. *Eurema dina parvumbra* (Kaye)

Eurema westwoodi: Fox and Johnson, 1893: 3.

Eurema citrina: Fox and Johnson, 1893: 3.

Terias dina parvumbra Kaye, 1926: 481.

Eurema dina parvumbra: Klots, 1929: 139.

The Jamaican subspecies is very similar to the Cuban one, differing principally in the great reduction of the marginal band, a characteristic Jamaican "dry" modification; the average size is also a little smaller. Females may lack any conspicuous orange

flush, but are not likely to be confused with any other Jamaican species. Well distributed in Jamaica, up to about 5000 feet.

Material examined: 138 specimens in the American Museum of Natural History, the Carnegie Museum, and the Museum of Comparative Zoology. Most of these belong to the magnificent series collected by Avinoff and Shoumatoff.

c. *Eurema dina helios* Bates

Eurema dina helios Bates, 1934: 133.

Terias dina helios: d'Almeida, 1936: 223.

Eurema helios helios: Bates, 1939a: 44.

The Bahaman subspecies is unusually small, though decidedly larger than the various *chamberlaini* forms. The ground color is usually bright orange, but one specimen in the type series is clear yellow, though not differing otherwise. In summer specimens there is a linear fuscous border on the fore wing above; in winter specimens this is wanting or barely indicated. There is no evident difference between Andros and New Providence specimens.

Material examined: 56 specimens, including the type series of *helios*, from New Providence and Andros, in the American Museum of Natural History, the Carnegie Museum, and the Museum of Comparative Zoology.

d. *Eurema dina mayobanex* (Bates) new combination

Eurema helios mayobanex Bates, 1939a: 45.

The writer's reasons for not following Bates' treatment of this and the preceding subspecies have already been discussed. In superficial appearance *mayobanex* resembles *dina dina* far less than does the sympatric *leuce memulus*. *Mayobanex* does, however, closely resemble the orange form of *dina westwoodii*, as well as the Bahaman *dina helios*, being about intermediate in size between these two forms. Unlike the other *dina* subspecies, *mayobanex* appears to be extremely rare, perhaps suffering from the competition of *leuce memulus*.

Material examined: 9 specimens, including the type material of *mayobanex*, from Ennery, Haiti, 2500 feet, and San Lorenzo, Dominican Republic, all taken in August, in the American Museum of Natural History, the Carnegie Museum, and the Museum of Comparative Zoology. The Carnegie Museum specimen is without precise data.

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